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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/669,047

09/23/2003

Paul DuBois

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EXAMINER

STEVENS, THOMAS H

ART UNIT

PAPER NUMBER

2121

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DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/669,047	Applicant(s) DUBOIS ET AL.	
	Examiner Thomas H. Stevens	Art Unit 2121	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 May 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 13 and 15-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 13 and 15-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09/23/2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>05/21/2007</u> . | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

1. Claims 13, 15-26 were examined.

Section I: Non-Final Rejection

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, *the calculating the plurality of stress functions is performed without guessing material coefficients, in a trial-and-error manner, to fit the strain-stress curve obtained in uni-axial test* must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement

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Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

3. Claims 13 objected to because of the following informalities (grammar): claim 13, line 10; claim 21, line 12; and claim 24, line 18; the word "function" is singular rather than plural. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 13, 15-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. "Rubber-like" is not adequately defined within the specification so that one of ordinary skill in the art would be appraised of the scope of the claim. Clarification is requested.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set

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forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 13,15-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher et al., titled, "An Efficient 3-D Visualization Technique for Finite Element Models and Other Coarse Volumes" (hereafter, Gallagher) in view of Ogden et al., titled, "A Pseudo-Elastic Model for the Mullins Effect in Filled Rubber" (hereafter Ogden) and in further view of Kakavas, titled, "Evaluation of the Derivatives of the Strain Energy Function with Respect to Strain Invariants for Carbon-Black Filled EPDM".

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Per claims 13, 20-24,26 Gallagher teaches

- finite element analysis (introduction, right column, 2nd paragraph)
- rubber-like material (pg. 191, right column, 6th paragraph, line 3)
- lookup table (pg. 187, left column, line 3)
- defining a plurality of elements and a strain-stress curve (pg.2872, figure)

But Gallagher and Kakavas fail to teach a plurality of stress functions, stain-stress curves, solving eigensolutions of a deformation gradient tensor, and transforming the principal stresses into global coordinate system all contained in a software package; and calculating the plurality of stress functions is performed without guessing material coefficients, in a trial-and-error manner, to which Ogden and Kakavas teaches, respectively,

Per claims 13, 18, 20-24,26 Ogden teaches

- iteratively calculating a plurality of stress function values at a plurality of corresponding stretch ratios (as defined in pg. 10, paragraph 0049, lines 4 and 5: pg. 2876, equation 5.2)
- associated stress values defined in the strain-stress curve (pg. 2872, figure 2)
- storing the plurality of stress function values into a stress function (pg. 2861, Introduction, software that's loaded on a computer e.g., ABAQUS and MARC)
- obtaining a set of principal stretches by solving eigensolution of a deformation gradient tensor (pg. 2863, "Basic Equations and Notation" section, lines 5-6) at each integration point of each of the elements

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- determining principal stresses (pg. 2864, last paragraph "Isotropy" section, lines 2-3) in principal directions from the stress function in accordance with the principal stretches
- transforming the principal stresses (pg. 2864, last paragraph "Isotropy" section, lines 2-3) into global coordinate system (pg. 2866, figure1, points on the curve)
- computer program product with code (pg. 2861, Introduction, software that's loaded on a computer e.g., ABAQUS and MARC)

Per claim 13,21, and 24 Kakavas teaches

- calculating the plurality of stress functions is performed without guessing material coefficients, in a trial-and-error manner (i.e., experimental or empirical data experimental data; pg. 1592, right column, second paragraph, lines 1-3), to fit the strain-stress curve obtained in uni-axial test

Therefore it would have been obvious to a person having ordinary skill in the art at the time of applicants' invention to modify Gallagher in view of Ogden and Kakavas because Ogden for the purpose of creating a model that is applicable to multiaxial states of stress and strain, not just specific uniaxial test (pg. 2861, 1st paragraph, last two lines) and Kakavas teaches a process that is based on Ogen's strain energy function that was used to fit the experimental data (pg. 1592, right column, second paragraph, lines 1-3).

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Per claim 14 Ogden teaches

- a uni-axial loading condition (pg. 2869, last paragraph)

Per claim 15 Ogden teaches

- the stretch ratio is a ratio between deformed lengths divided by original length (as defined in pg. 10, paragraph 0049, lines 4 and 5: pg. 2876, equation 5.2) in one direction.

Per claim 16 Ogden teaches

- the stretch ratio is equal to strain of the rubber-like material minus 1 (pg. 2874, lines 5 and 6).

Per claim 17 Ogden teaches

- Claim 17. The method of claim 13, wherein the strain (pg. 2872, figure 2) has a range between -0.8 and 1.2 (design choice)

Per claims 18, 22, 25 Ogden teaches

- (a) calculating a function value by multiplying an initial stretch ratio with the associated stress value at lambda minus 1 (as defined in pg. 10, paragraph 0049, lines 4 and 5: pg. 2876, equation 5.2)
- (b) initializing (initiate the software, pg 2870, paragraph above equation 3.26) an old stretch ratio old with the initial stretch ratio (initiate the software, pg 2870, paragraph above equation 3.26; pg. 2873); (c) calculating a new stretch ratio

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new as an inverse of square root ratio (pg. 2876, equation 5.2) of the old stretch ratio old; (d) when absolute value of is less than or equal to a predetermined threshold (pg. 2875, last paragraph, damage threshold), assigning the function value to a particular one of the stress function values (pg. 2864, last paragraph "Isotropy" section, lines 2-3) corresponding to the initial stretch ratio (pg. 2864, last paragraph "Isotropy" section, lines 2-3) (e) otherwise, adjusting the function value by adding another term, wherein another term (pg. 2876, equation 5.2, other term being λ^2) is calculated by multiplying the new stretch ratio new with the associated stress value at new -1 (pg. 2874, lines 5 and 6); assigning the new stretch ratio new to the old stretch ratio old (pg. 2874, lines 5 and 6); and repeating (c), (d) and (e), until (d) has been satisfied.

Per claim 19 Ogden teaches

- the predetermined threshold (pg. 2875, last paragraph, damage threshold) is 0.01 (design choice).

Per claim 24 Gallagher teaches

- an I/O interface (pg. 191, "Graphics Display Considerations" left side, 2nd paragraph; a communication interface; a secondary memory; a main memory for storing computer readable code for an application module; at least one processor coupled to the main memory, the secondary memory, the I/O interface, and the communication interface, said at least one processor executing the computer

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readable code in the main memory to cause the application (to one of ordinary skill realizes these limitations as typical computer products to which computer aided design software runs on, pg. 185, left side "CR Categories", i.e. CAD, Computer graphics, etc.).

Section II: Response to Arguments

IDS

6 Applicants are thanked for addressing this issue; objection is withdrawn.

103

7. Applicants are thanked for addressing this issue. The amendments to the independent claims are anticipated by Kakavas, (as mentioned in the first office action) as set forth above, in which said trial and error limitation is equivalent to the event of experimentation (Kakavas pg. 1591-1592 "Evaluation for Rubber-Like Materials Subjected to Uniaxial Tension"; e.g., pg.1591, "Experimental –Materials Used").

Applicants' admission of the limitations by Gallagher of "rubber", "finite element" and "look-up" tables validates the Office's position of analogous art, reflecting engineering based tools that can be used in conducting "rubber like"

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engineering analysis. Furthermore, the Office refutes applicants' assertion of impermissible hindsight since the motivation to combine stems from the prior art.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicants' disclosure:

- Ogden- R.W., "On the Anisotropy of Compressibility of Rubber-Like Solids" 1979, The Institute of Physics pg. 465-479; teaches an approach based on general theory of isotropic elasticity and the physical approach based on the statistical-mechanical theory of rubber elasticity.
- Chang et al., "Large Strain Analysis of Rubber-Like Materials based on a Perturbed Lagrangian Variational Principle" 1991 Computational Mechanics, abstract, pg.1-5; teaches a mixed finite element method presented for the large strain analysis of rubber-like materials which are nearly incompressible
- Basar et al., "Finite Element Formulation of the Ogden Material Model with Application to Rubber-Like Shells" 1998 abstract pg.1279-1305; teaches a variation procedure for the numerical implementation of the Ogden material model.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mr. Tom Stevens whose telephone number is 571-272-3715.

If attempts to reach the examiner by telephone are unsuccessful, please contact examiner's supervisor Mr. Anthony Knight 571-272-3687. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

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published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. to questions regarding access to the Private PAIR system, contact the Electronic Business Center (EBC) (toll-free (866-217-9197)).



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